UNIVERSITY OF MALAYA

# A STUDY ON COMFORT AND SATISFACTION AMONG PUBLIC EMPLOYEES: COMPARISON BETWEEN CONVENTIONAL & GREEN BUILDING

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## Presentation Outline

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The increasing acceptance of green building concept is due to its overwhelming outcome towards ensuring optimum use of resources which resulted in improvement of overall impact towards the environment, occupants' well-being and health. Despite the positive outcomes, only seven governments buildings have embraced the commitment to getting green building index certification in Malaysia. In fact, few studies conducted shows the impact of green building towards the well-being of its occupants has produced inconclusive and mixed results about the level of comfort and satisfaction compared to its counterparts, conventional building. Thus, the objective of the study is to investigate the differences in respondents' perceived comfort, satisfaction and sustainable practices based on conventional and green certified building. The second objective is to understand the relationship between respondent's perceived comfort and satisfaction in both buildings. The study employed a quantitative method involving correlational and cross-sectional design. The respondents comprised of public employees who were working at a newly certified building, Menara Kerja Raya at Kuala Lumpur. The respondents also had prior experiences working in conventional buildings before moving into the Menara Kerja Raya. Self-administered questionnaires were distributed to 312 respondents selected through a systematic random sampling technique. Furthermore, paired sample t-test was conducted to investigate whether there are any differences in respondents' perceived comfort, satisfaction and sustainable practices while working at conventional building versus green-certified building. The results indicated that the respondents experienced a higher level of comfort (29%), satisfaction (14%) and sustainable practices (14%) while working in the

green building, i.e. Menara Kerja Raya compared to while working in the conventional building. Moreover, multiple linear regression test was performed to understand the relationship between perceived comfort and satisfaction in both buildings. The finding demonstrated that there was a positive relationship between respondents' comfort and satisfaction in both buildings. In a conventional building, the result showed that comfort has 61% influenced by satisfaction. Whereas, in Menara Kerja Raya, comfort has 59% influenced by satisfaction. The findings provided some evidence concerning the factors such thermal comfort, acoustic comfort, visual comfort and indoor air quality comfort that were essential for improving the level of comfort and satisfaction among respondents working in the green building. The results indicated that to turn off lights and to put the computer on sleep-mode or turn it off were the most common practices related to sustainability behaviours among respondents at both types of buildings. These findings would assist relevant government agencies to develop appropriate measures and sustainability programs to initiate more government building to be certified with green building certification. With the increased level of comfort and satisfaction as well as sustainable practices, while working in the green building, it should be a strong justification to increase the number of green building construction and development in the future.

Keywords: Environment, Sustainability, Energy, Recycle, Happiness

# Introduction

RMK11 and ETP Plans aim for efficient physical infrastructure developments to meet the increasing demand -→ developed and high-income country by 2020 (CIDB, 2016).

**Construction industry's contribution**

4.5 % Malaysia GDP


1.3 % registered employees

Job opportunities (DOSM, 2016)

M 12 relying companies

Two-times multiplier effect

0

**Type of Construction in Malaysia**

| | |
|---|---|
| Social Amenities | Infrastructure |
| Residential | Non-Residential |

## Environmental Effects

Reported by UNEP in 2009

40% CO2 Emissions

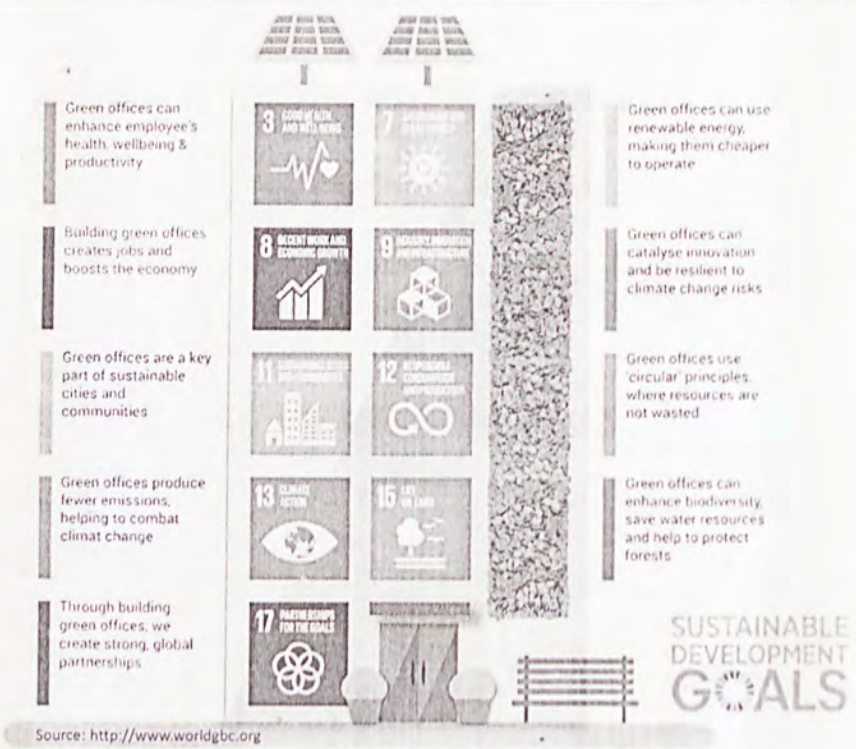
60% Non-industrial waste

70% Electricity

volume materials & water usage

# Introduction

In 2010, Malaysia is moving to green building construction




Source: http://www.worldgbc.org

## Problem Statement

Level of satisfaction over indoor environments resulted from the inclusion of features contributed to green buildings do not always fit the expectations of the design intent (Baird, Leaman, & Thompson, 2012; Leaman & Bordass, 2001, 2007; Turner & Frankel, 2008).

**Low uptake of green building technology in government office**

7 government offices → Green Building Index (GBI) certified (GBI, 2017)

Public service has become such a big organisation → require a **broad span of floor area** with the conducive indoor environment

## Literature Review

| | |
|---|---|
| ▪ People spend their lives 85 to 90 percent a day in buildings | (Liqun & Yanqun, 2011) |
| Building services<br>▪ Building services and infrastructures –influence on comfort, satisfaction and occupant's quality of life. | (Mustafa, 2017) |
| Indoor Environmental Quality<br>Healthy building that incorporate various factors such as thermal, acoustic, air quality, visual and lighting comfort called IEQ. | (MacNaughton et al., 2017) |
| The changing seasons cause variability on temperatures -affect occupants' comfort in green building | (Edwards, 2006). |
| The indoor environment of green library in Australia during summer as perceived by user as warmer and less comfortable | (Paul, 2008) |

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## Literature Review

| | |
|---|---|
| Satisfaction<br>A study conducted in Australia → challenged the claims that green building perform better than their conventional counterparts and are healthier for occupants. | (Wilkinson, Reed, & Jailani, 2011) |
| Sustainable Practices<br>In Virginia Tech's campus, the result suggest that green certified and green features building did influences occupants significantly to exhibit pro-environmental behavior. | (Hill, Taylor, Pearce, & Shealy, 2016) |
| The availability of studies on the importance of social and economic aspects of green building are comparatively lean which required more robust studies to validate the real performance of green building via Post-occupancy Evaluation (POE). | (Zuo & Zhao, 2014) |

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## Gap From Previous Studies

1. Limited comparative study in assessing level of comfort and satisfaction from the **same respondents**
2. Limited study in assessing **sustainable practices** incorporated with comfort and satisfaction
3. Common green building themes from previous study:
   - definition & scope
   - benefits & costs
   - ways to achieve green building. (Zuo & Zhao, 2014)
4. Limited number of papers investigated comfort and satisfaction in green building with reference to non-green buildings in Malaysia

## Research Objectives

1. To investigate **perceived comfort** in conventional and green building
2. To investigate **perceived satisfaction** in conventional and green building
3. To investigate the **relationship** between the **perceived comfort** and **satisfaction**
4. To identify **sustainable practices** in conventional and green building

❖ *Same respondents who have experience working in conventional and green building*

## Methodology

- Literature review
- Questionnaire → Modification based on previous studies (Amirazar et al., 2016; Nazli Che Din et al., 2014)

Sample Size

- Distributed = 312
- Returned = 198

## Research Framework

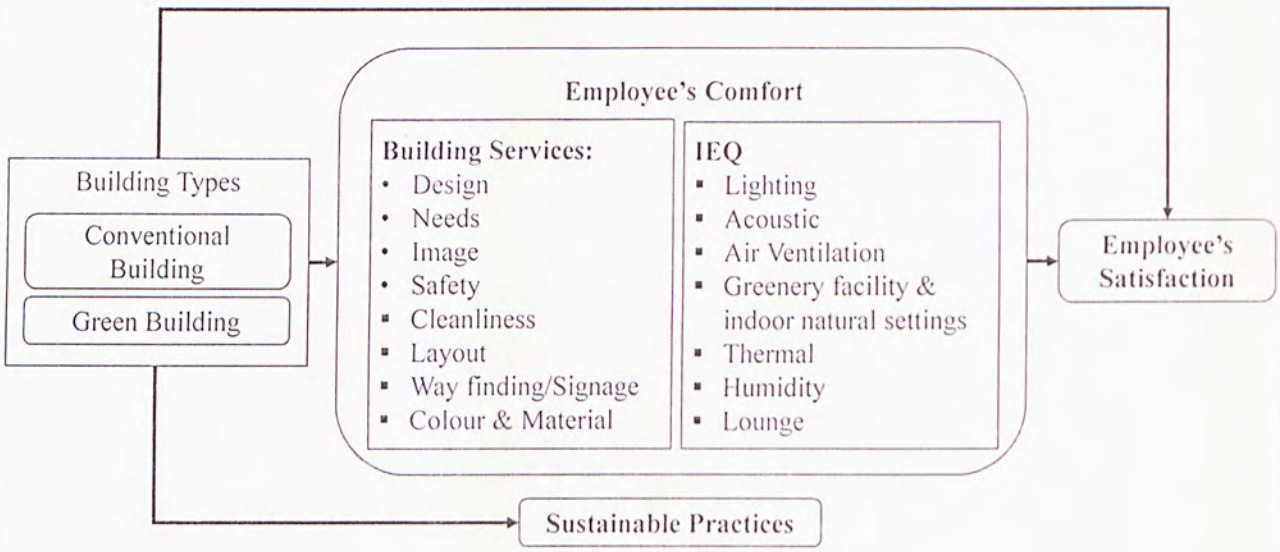


*Figure 1: Framework of the study*

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Table 4.1: The Profile of the respondents

| No. | Profile | No | % |
|---|---|---|---|
| 1. | Gender | | |
| | Female | 118 | 59.6 |
| | Male | 80 | 40.4 |
| 2. | Age Group | | |
| | 20 years and below | 1 | 0.5 |
| | 21 - 30 years old | 54 | 27.3 |
| | 31 - 40 years old | 80 | 40.4 |
| | 41 - 50 years old | 40 | 20.2 |
| | 51 - 60 years old | 23 | 11.6 |
| 3. | Academic background | | |
| | SPM | 52 | 26.3 |
| | STPM/Diploma | 64 | 32.3 |
| | Bachelor's Degree | 66 | 33.3 |
| | Master's Degree/PhD | 16 | 8.1 |
| 4. | Service Group | | |
| | Management & Professional (Technical) | 41 | 20.7 |
| | Management & Professional (Administrative) | 24 | 12.1 |
| | Support group (Technical) | 71 | 35.9 |
| | Support group (Administrative/Operational) | 62 | 31.3 |

Table 4.2: Working Background

| No. | Profile | No | % |
|---|---|---|---|
| 1. | Working Duration in Menara Kerja Raya | | |
| | Less than 1 year | 42 | 21.2 |
| | 1 year and above | 156 | 78.8 |
| 2. | Working Experience in conventional building | | |
| | Yes | 198 | 100.0 |
| | No | 0 | 0.0 |
| 3. | Working Experience in green building | | |
| | Yes | 198 | 100.0 |
| | No | 0 | 0.0 |
| 4. | Work station occupancy | | |
| | Occupied alone | 95 | 48.0 |
| | Shared with 1 other | 16 | 8.1 |
| | Shared with 2- 4 others | 51 | 25.8 |
| | Shared with more than 5 others | 36 | 18.2 |

## Result & Discussion

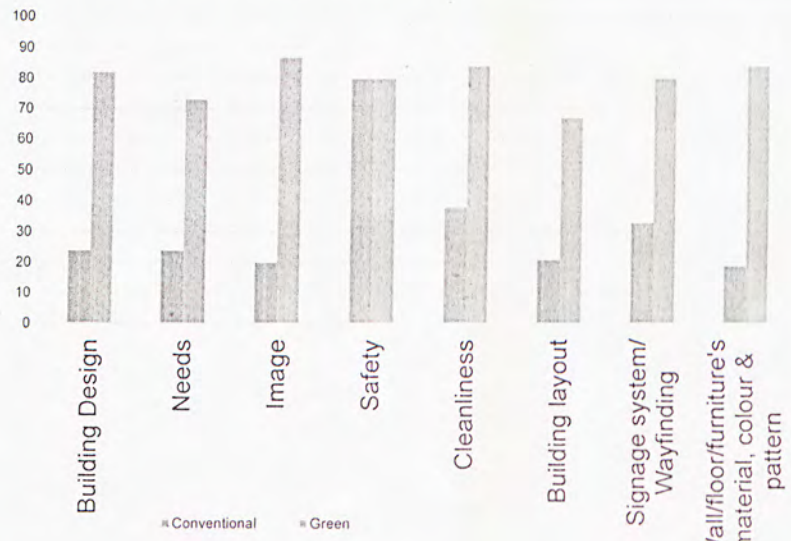
Objective 1: To investigate comfort in conventional and green building

RQ 1

15 elements of comfort

- Building Services Comfort
  - Design
  - Needs
  - Image
  - Safety
  - Cleanliness
  - Layout
  - Wayfinding/Signage
  - Wall/floor/furniture's material colour & pattern)
- Indoor Environmental Quality Comfort
  - Lighting brightness & colour
  - Acoustic/noise level
  - Air ventilation
  - Greenery facility & indoor natural setting
  - Thermal
  - Humidity
  - Lounge

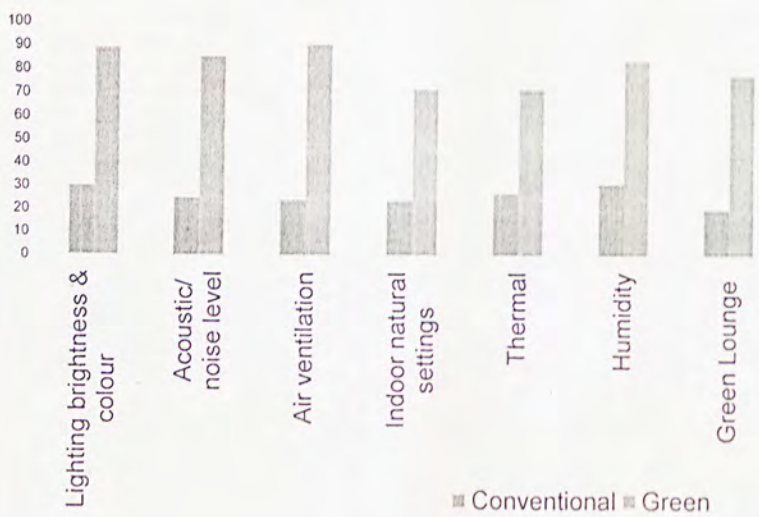
## Comparison of Building Services Comfort between Conventional and Green Building




Conventional building
Only safety score 80%

Green building
Design, image, safety, cleanliness, material
Score >80% comfort

## Comparison of Indoor Environmental Quality (IEQ) Comfort between Conventional and Green Building




Result shows **3 times higher of IEQ comfort** in green building compared to conventional building

## Service Group in Green Building (Comfort)

| Model | | Unstandardized Coefficients B | Unstandardized Coefficients Std. Error | Standardized Coefficients Beta | t | Sig. |
|---|---|---|---|---|---|---|
| 1 | (Constant) | 4.069 | .068 | | 59.413 | .000 |
| | Management & Professional (Technical) | -.157 | .109 | -.118 | -1.443 | .151 |
| | Management & Professional (Administrative) | -.105 | .130 | -.064 | -.809 | .419 |
| | Support Group (Technical) | -.103 | .094 | -.092 | -1.095 | .275 |

a. Dependent Variable: Mean comfort of Green Building

1. Management & Professional (Technical) vs Support Group (Administrative)
   *= Lower comfort, not significant*
2. Management & Professional (Admin.) vs Support Group (Administrative)
   *= Lower comfort, not significant*
3. Support Group (Technical) vs Support Group (Administrative)
   *= Lower comfort, not significant*

## Work Station Occupancy in Green Building (Comfort)

| Model | | Unstandardized Coefficients B | Unstandardized Coefficients Std. Error | Standardized Coefficients Beta | t | Sig. |
|---|---|---|---|---|---|---|
| 1 | (Constant) | 3.952 | .054 | | 73.316 | .000 |
| | Twin occupancy | -.315 | .142 | -.160 | -2.217 | .028 |
| | 2 to 4 Occupancy | .205 | .091 | .167 | 2.243 | .026 |
| | > 4 Occupancy | .040 | .103 | .029 | .392 | .695 |

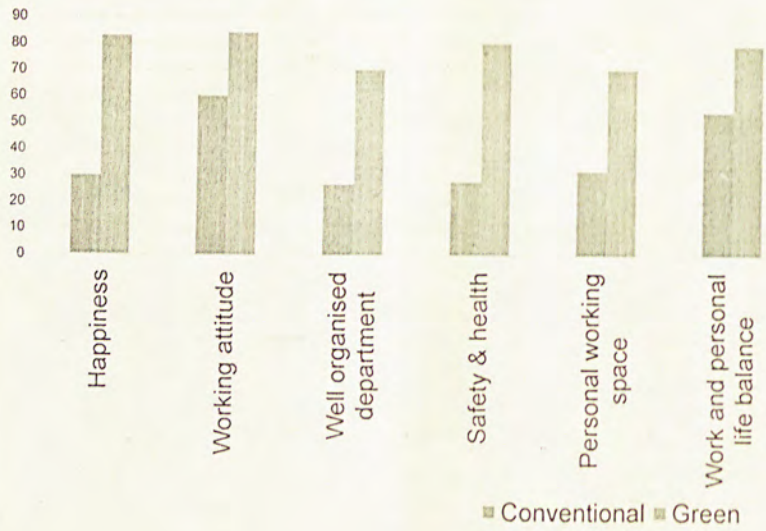
a. Dependent Variable: Mean comfort of green building

1. Twin occupancy vs Single occupancy — *= Lower comfort, significant*
2. 2 - 4 occupancy vs Single occupancy — *= Higher comfort, significant*
3. > 4 occupancy vs Single occupancy — *= Higher comfort, not significant*

## Result & Discussion

Objective 2: To investigate **perceived satisfaction** in conventional and green building

- 6 elements of satisfaction:
  - Happiness to work;
  - Preference to the job (working attitude);
  - Well organized department;
  - Safety and health standards;
  - Personal space;
  - Personal work, life balance.




> 80% → Higher satisfaction in Happiness and working attitude in green building

Largest difference over than 52% → satisfaction in item safety & health standards compared to conventional building

## Service Group in Green Building (Satisfaction)

| Model | Unstandardized Coefficients B | Unstandardized Coefficients Std. Error | Standardized Coefficients Beta | t | Sig. |
|---|---|---|---|---|---|
| 1 (Constant) | 3.949 | .072 | | 54.829 | .000 |
| Management & Professional (Technical) | -.152 | .114 | -.109 | -1.333 | .184 |
| Management & Professional (Administrative) | .002 | .136 | .001 | .018 | .986 |
| Support Group (Technical) | -.050 | .099 | -.042 | -.506 | .614 |

a. Dependent Variable: Mean Satisfaction of Green Building

1. Management & Professional (Technical) vs Support Group (Administrative)
   *= Lower satisfaction, not significant*
2. Management & Professional (Admin.) vs Support Group (Administrative)
   *= Higher satisfaction, not significant*
3. Support Group (Technical) vs Support Group (Administrative)
   *= Lower satisfaction, not significant*

## Results

The ~~effect of Work Station Occupancy on~~
Emp

| Model | Unstandardized Coefficients B | Unstandardized Coefficients Std. Error | Standardized Coefficients Beta | t | Sig. |
|---|---|---|---|---|---|
| 1 (Constant) | 3.932 | .058 | | 68.360 | .000 |
| Twin occupancy | -.296 | .151 | -.143 | -1.955 | .052 |
| 2 to 4 Occupancy | .065 | .097 | .050 | .670 | .504 |
| > 4 Occupancy | -.135 | .110 | -.092 | -1.233 | .219 |

a. Dependent Variable: Mean Satisfaction of Green Building

1. Twin occupancy vs Single occupancy — *= Lower satisfaction, not significant*
2. 2 - 4 occupancy vs Single occupancy — *= Higher satisfaction, not significant*
3. > 4 occupancy vs Single occupancy — *= Lower satisfaction, not significant*

# Objective 3

## Multilinear Regression: Conventional Building Assessment

**Model Summary[b]**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics: R Square Change | F Change | df1 | df2 | Sig. F Change | Durbin-Watson |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .785[a] | .617 | .613 | .36247 | .617 | 156.790 | 2 | 195 | .000 | 2.026 |

In this analysis, about 62% variance in **employee satisfaction in conventional building** is explained by all the predictors.

## Multilinear Regression: Green Building Assessment

**Table XX: Model Summary[b]**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics: R Square Change | F Change | df1 | df2 | Sig. F Change | Durbin-Watson |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .768[a] | .589 | .585 | .36446 | .589 | 139.803 | 2 | 195 | .000 | 1.979 |

a. Predictors: (Constant), IEQ_G, BS_G

b. Dependent Variable: ES_G

In this analysis, about 59% variance in **employee satisfaction in green building** is explained by all the predictors.

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# Objective 3

## Multilinear Regression: Conventional Building Assessment

Employee's satisfaction can **significantly** be predicted from a set of two predictors namely:

- Building services comfort
- Indoor Environmental Quality comfort

**Model Summary[b]**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics: R Square Change | F Change | df1 | df2 | Sig. F Change | Durbin-Watson |
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|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .768[a] | .589 | .585 | .36446 | .589 | 139.803 | 2 | 195 | .000 | 1.979 |

a. Predictors: (Constant), IEQ_G, BS_G

b. Dependent Variable: ES_G

In this analysis, about 59% variance in **employee satisfaction in green building** is explained by all the predictors.

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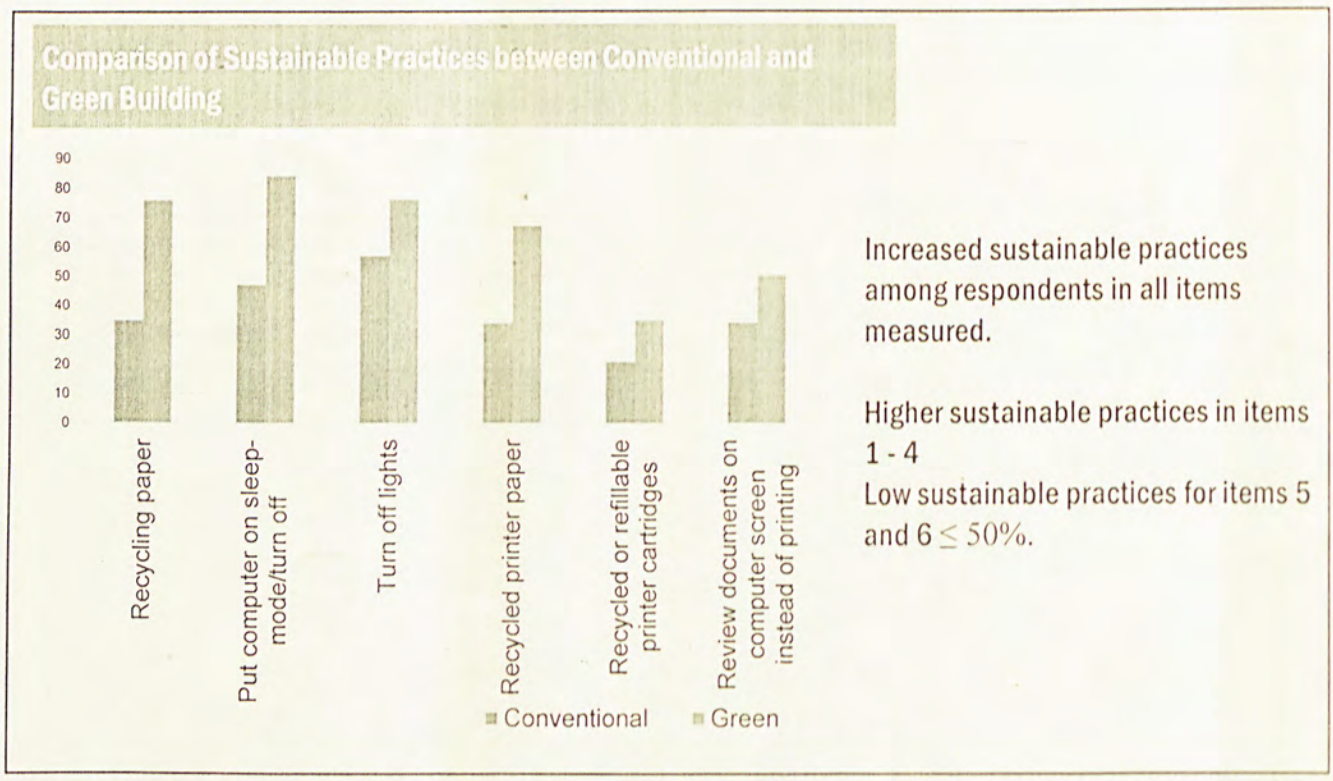
## Result & Discussion

Objective 4: To investigate **sustainable practices** in conventional and green building

- 6 elements of sustainable practices:
  - Recycling paper
  - Put computer on sleep-mode/turn off
  - Turn off lights
  - Recycled printer paper
  - Recycled or refillable printer cartridges
  - Review documents on computer screen instead of printing)




Increased sustainable practices among respondents in all items measured.

Higher sustainable practices in items 1 - 4

Low sustainable practices for items 5 and 6 $\leq 50\%$.

## Results on comparison of comfort, satisfaction and sustainable practices

| | | Paired Differences | | | | | t | df | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference Lower | Upper | | | |
| Pair 1 | EC_G - EC_C | .89933 | .54197 | .03852 | .82337 | .97528 | 23.350 | 197 | .000 |
| Pair 2 | ES_G - ES_C | .54798 | .56358 | .04005 | .46899 | .62697 | 13.682 | 197 | .000 |
| Pair 3 | SP_G - SP_C | .44781 | .46729 | .03321 | .38232 | .51330 | 13.485 | 197 | .000 |

1. Level of **comfort** between working in conventional and green building = **Significant**
2. Level of **satisfaction** between working in conventional and green building = **Significant**
3. Level of **sustainable practices** between working in conventional and green building = **Significant**

## Conclusion

- 2 Categories of Comfort
  - Building services
  - Indoor Environmental Quality
- All 15 items → Rated higher comfort in green building

### Building services | Conventional Building |

- Only Safety > 80%
- 7 other items < 40%

### Building services | Green Building |

- 75% of BS comfort items ≥ 80%
- Lower comfort in items →
  - Needs
  - Building Layout
- Previous study → Lower comfort in building layout due to lack of privacy & poor visual privacy (Wilkinson et al., 2011).

## Conclusion

### IEQ | Conventional Building |

- Low figure of average 25% of respondents feel comfort

### IEQ | Green Building |

- > 80% → Higher comfort in items
  - Lighting brightness & colour
  - Acoustic
  - Air ventilation
  - Humidity
- Lower comfort in items Thermal & indoor natural settings
- Many previous studies → Thermal contributes to discomfort:
  - Lack of occupants control over air conditioning system (Steemers & Manchanda , 2010)
  - Fully glazed façade (Wong et al., 2005)

### | Multilinear Regression of Service Group on Comfort |

1. Management & Professional (Technical)
2. Management & Professional (Admin)
3. Support Group (Technical)

} Support Group (Admin)

*= Lower comfort, not significant*

### | Multilinear Regression of Work Station Occupancy on Comfort

1. Twin occupancy
2. 2 - 4 occupancy
3. > 4 occupancy

} Single occupancy

*Only Item 1 & 2 Lower found significant*

## Conclusion

- All 6 items → Rated higher satisfaction in green building

### Satisfaction | Conventional Building |

- Smaller difference in satisfaction → <30% respondents over item
  - Preference to the job.
  - Personal work, life balance.

### Satisfaction | Green Building |

- > 80% respondents → 50% of Satisfaction items
- Lower satisfaction in items →
  - Well organized department
  - Personal working space
- Similar result from previous study → due to lack of privacy (Wilkinson et al., 2011).

### | Multilinear Regression of Service Group on Comfort |

1. Management & Professional (Technical)
2. Management & Professional (Admin)
3. Support Group (Technical)

} Support Group (Admin)

*Only item 2 found to have an increase satisfaction, however not significant*

### | Multilinear Regression of Work Station Occupancy on Comfort

1. Twin occupancy
2. 2 - 4 occupancy
3. > 4 occupancy

} Single occupancy

*Only item 2 found to have an increase satisfaction, however not significant*

## Conclusion

- All 6 items → Rated higher sustainable practices in green building

## Sustainable Practices

- Higher sustainable practices on common practices → > 50% respondents over item:
  - Turn-off lights
- ≤ 50% respondents → Recycling printer cartridges and reviewing documents on computer seems not commonly practiced among public employee

## Conclusion

### IEQ | Conventional Building |

- Low figure of average 25% of respondents feel comfort

### IEQ | Green Building |

- > 80% → Higher comfort in items
  - Lighting brightness & color
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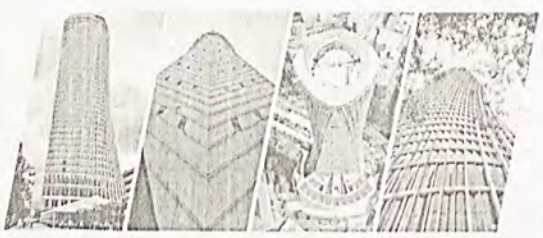

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